UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte RAYMOND LEE LAVOIE, JR.,
JOHN QUANCI, and QIANQIU YE

Appeal 2007-2762
Application 10/785,666
Technology Center 3700

Decided: November 30, 2007

Before CHARLES F. WARREN, THOMAS A. WALTZ, and
LINDA M. GAUDETTE, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge.*

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner finally rejecting claims 1, 3 through 5, and 8 through 10 in the Office Action mailed July 12, 2006, and refusing to allow claims 2, 6, and 7 in the Office Action mailed August 29, 2006. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 41.31(a) (2006).

We affirm the decision of the Primary Examiner.

Claim 1 illustrates Appellants' invention of a polishing composition for semiconductor substrates having a non-ferrous interconnect, and is representative of the claims on appeal:

1. A polishing composition suitable for polishing semiconductor substrates having a non-ferrous interconnect comprising:

0.1 to 1.5 wt% of a polyvinyl alcohol; 0.01 to 0.85 wt.% of polyvinylpyrrolidone;

up to 10 wt% of a corrosion inhibitor;

up to 15 wt% complexing agent;

up to 10 wt% of an oxidizing agent; and

0.05 to 40 wt% of an abrasive wherein the polishing composition has a pH of at least 7 and wherein increasing the weight ratio of the polyvinyl alcohol to the polyvinylpyrrolidone decreases the polishing removal rate of the non-ferrous interconnect.

The Examiner relies upon the evidence in these references (Ans. 3):

Tsuchiya	US 2002/0095872 A1	Jul. 25, 2002
Kurata	US 2003/0219982 A1	Nov. 27, 2003

Appellants request review of the ground of rejection under 35 U.S.C. § 103(a) advanced on appeal: claims 1 through 10 as unpatentable over Tsuchiya in view of Kurata. App. Br. 3;[1] Ans. 3.

Appellants argue the claims in the ground of rejection as a group. App. Br. in entirety. Thus, we decide this appeal based on claim 1. 37 C.F.R. § 41.37(c)(1)(vii) (2006).

The issue in this appeal is whether the Examiner has carried the burden of establishing a prima facie case of obviousness in the ground of

[1] We cite to the unnumbered pages of the Brief.

rejection advanced on appeal.

The plain language of claim 1 specifies a composition capable of polishing semiconductor substrates having a non-ferrous interconnect, comprising at least the ingredients polyvinyl alcohol, polyvinylpyrrolidone, and an abrasive, each in an amount falling within the specified range for that ingredient, wherein the composition has a pH of at least 7. The "up to" limitation in the weight percent ranges of the ingredients corrosion inhibitor, complexing agent, and oxidizing agent does not state a lower limit, and thus, the lower limit is any amount of the ingredient, however small. With respect to the complexing agent, the lower limit of the range can be "0.0" as the Specification discloses that this ingredient is optional. *See* Spec., e.g., ¶¶ 0023, 0024, and 0027. *See In re Mochel*, 470 F.2d 638, 640 (CCPA 1972) ("As this Court has held, the phrase 'up to' of claim 2 includes zero as the lower limit. [Citations omitted.]").

The Specification lists, among other things, the following examples of particular ingredients: corrosion inhibitor, benzotriazole; complexing agent, citric acid; oxidizing agent, hydrogen peroxide; and abrasive, silica and alumina. Spec., e.g., ¶¶ 0018, 0023, 0025, and 0027. Non-ferrous interconnects include, among other things, copper. Spec. ¶ 0002.

The transitional term "comprising" opens the claim to include compositions which contain additional ingredients in any amount. *See, e.g.*, *Exxon Chem. Pats., Inc. v. Lubrizol Corp.*, 64 F.3d 1553, 1555 (Fed. Cir. 1995) ("The claimed composition is defined as comprising - meaning containing at least - five specific ingredients."); *In re Baxter*, 656 F.2d 679, 686 (CCPA 1981) ("As long as one of the monomers in the reaction is

propylene, any other monomer may be present, because the term 'comprises' permits the *inclusion* of other steps, elements, or materials.").

We agree with the Examiner that the claim language "wherein increasing the weight ratio of the polyvinyl alcohol to the polyvinylpyrrolidone decreases the polishing removal rate of the non-ferrous interconnect" in claim 1 does not limit the encompassed compositions in any respect. Ans. 4, 8-9, and 10-11. As the Examiner determines, claim 1 encompasses any single composition containing any wt% of polyvinyl alcohol and any wt% of polyvinylpyrrolidone which fall within the wt% ranges specified for these ingredients, regardless of the weight ratio of the polyvinyl alcohol to the polyvinylpyrrolidone in the composition. In other words, the subject clause specifies no limitation on the weight ratio of polyvinyl alcohol to polyvinylpyrrolidone for a single composition to which claim 1 is directed, and expresses at most Appellants' discovery of a relative property of the range of single compositions encompassed by claim 1. *See* App. Br. 5.

We find Tsuchiya would have disclosed to one of ordinary skill in this art a chemical mechanical polishing (CMP) composition for semiconductor substrates having a non-ferrous interconnect, such as copper, which can contain, among other things: 0.1 to 50 wt% of a polishing material, such as silica and alumina; 0.01 to 15 wt% of an oxidizing agent, such as hydrogen peroxide; 0.001 to 5 wt% of a proton donor as an oxidizing aid, such as citric acid; and 0.0001 to 5.0 wt% of an antioxidant, such as benzotriazole. Tsuchiya, e.g., ¶¶ 0026-0031, 0044-0051, and 0057. Tsuchiya's compositions further contain a thickener, the selection of which

depends on the selection of the polishing agent. If the polishing agent is either silica or alumina, the thickener can be, among other things, a nonionic water-soluble polymer, such as polyvinyl alcohol and polyvinylpyrrolidone. Tsuchiya discloses that the thickener content must be 0.001 to less than 0.05 wt%. Tsuchiya teaches "a too large content may lead to an inadequate polishing rate" but does not specify the "too large content" or the "inadequate polishing rate." Tsuchiya, e.g., ¶¶ 0032-0041. Tsuchiya discloses the pH of the composition is preferably 9 or less, and is selected "in the light of a polishing rate, corrosion, a slurry viscosity and dispersion stability of a polishing material." Tsuchiya ¶¶ 0052-0053.

We find Kurata would have disclosed to one of ordinary skill in this art a CMP composition for semiconductor substrates having a non-ferrous interconnect, such as copper and copper alloy, which can contain, among other things, in moles with respect to the total weight (100g) of the composition or in wt%: 0.003 to 0.7 mol of an oxidizing agent, such as hydrogen peroxide; 0.00001 to 0.005 mol of an oxidized metal dissolving agent, such as citric acid; 0.00001 to 0.05 mol of a protective film forming agent, such as benzotriazole; and "preferably 0.001-0.3 weight %" of "at least one" water soluble polymer which can be, among other things, a vinyl-based polymer, such as polyvinyl alcohol and polyvinylpyrrolidone. Kurata, e.g., ¶¶ 0041-0050. Kurata discloses "that the use of a protective film forming agent in combination with a water-soluble polymer allows high a [sic] CMP rate, while the etching at a metal layer, such as copper alloy is suppressed sufficiently low." Kurata ¶ 0037. Kurata discloses that if the amount of protective film forming agent exceeds 0.5 wt% or 0.05 mol,

the CMP rate tends to be decreased. Kurata ¶¶ 0035-0036 and 0048. Kurata further discloses that "when the content of the water-soluble polymer exceeds 0.3 weight %, the CMP rate tends to be decreased." Kurata ¶ 0049.

Kurata teaches that "[i]t is acceptable that the polishing liquid for metal of the present inventions contains substantially no solid polishing particles." Kurata ¶ 0041; *see also* ¶ 0053. We find the term "substantially" would have its ordinary meaning in context to one of ordinary skill in this art as permitting a small amount of "polishing particles" which are known in the art, such as silica and alumina as disclosed by Tsuchiya.[2] *See, e.g. York Prods., Inc. v. Central Tractor Farm & Family Ctr.*, 99 F.3d 1568, 1572-73 (Fed. Cir. 1996) ("In this case, the patent discloses no novel use of claim words. Ordinarily, therefore, 'substantially' means 'considerable in . . . extent,' *American Heritage Dictionary Second College Edition* 1213 (2d ed. 1982), or 'largely but not wholly that which is specified,' *Webster's Ninth New Collegiate Dictionary* 1176 (9th ed. 1983).").

We determine the combined teachings of Tsuchiya and Kurata, the scope of which we determined above, provide convincing evidence supporting the Examiner's case that the claimed invention encompassed by claim 1, as we interpreted this claim above, would have been prima facie obvious to one of ordinary skill in the semiconductor fabrication arts

[2] It is well settled that a reference stands for all of the specific teachings thereof as well as the inferences one of ordinary skill in this art would have reasonably been expected to draw therefrom, *see In re Fritch*, 972 F.2d 1260, 1264-65 (Fed. Cir. 1992); *In re Preda*, 401 F.2d 825, 826 (CCPA 1968), presuming skill on the part of this person. *In re Sovish*, 769 F.2d 738, 743 (Fed. Cir. 1985).

familiar with forming non-ferrous interconnects with metal films on semiconductor substrates and CMP compositions for the metal film containing semiconductor substrates.

We determine one of ordinary skill in this art would have combined the teachings of Tsuchiya and Kurata because the references are directed to CMP compositions which contain the same ingredients and are applied to the same semiconductor substrates having a non-ferrous interconnect. This person would have recognized from Kurata that at least one, and thus more than one, water-soluble polymer can be used in the compositions, and from both references that a combination of water-soluble polymers can be non-ionic, vinyl-based polyvinyl alcohol and polyvinylpyrrolidone. This person would have further recognized from Kurata that the amount of water-soluble polymer contained by such compositions can be higher than the amount of the same ingredients taught by Tsuchiya, and indeed, would have reasonably inferred from the disclosure in each reference in this respect, that to exceed the stated amount may, that is, tends to, result in some decrease in the CMP rate.

We determine that this person, armed with the knowledge provided by the combination of references, would have nonetheless used the higher amount of the water-soluble polymers taught by Kurata in determining a workable or optimum weight percent range for such ingredients in preparing a composition within the teachings of either reference. *Cf. In re Geisler*, 116 F.3d 1465, 1471 (Fed. Cir. 1997) ("The statement in Zehender that '[i]n general, the thickness of the protective layer should not be less than about [100 Angstroms]' falls far short of the kind of teaching that would

discourage one of ordinary skill in the art from fabricating a protective layer of 100 Angstroms or less."); *see, e.g.*, *In re Boesch*, 617 F.2d 272, 275-76 (CCPA 1980) (the prior art would have suggested the experimentation necessary to achieve the claimed compositions as discovery of an optimum value of a result effective variable in a known process is ordinarily within the skill of the art); *In re Aller*, 220 F.2d 454, 456-58 (CCPA 1955) (it is not inventive to discover by routine experimentation optimum or workable ranges for general conditions disclosed in the prior art).

We further determine that the range of suitable wt% amounts of the water-soluble polymers taught by Kurata overlaps with the combined wt% ranges for polyvinyl alcohol and polyvinylpyrrolidone specified in claim 1, which is 0.11 to 2.35 wt%. In this respect, it is well settled that where the prior art describes the components of a claimed composition in concentrations within or overlapping the claimed concentrations, a prima facie case of obviousness is established. *See In re Harris*, 409 F.3d 1339, 1343 (Fed. Cir. 2005); *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003); *Geisler*, 116 F.3d at 1469; *In re Woodruff*, 919 F.2d 1575, 1578 (CCPA 1990); *In re Malagari*, 499 F.2d 1297, 1303 (CCPA 1974).

Accordingly, we are of the opinion that one of ordinary skill in this art routinely following the combined teachings of Tsuchiya and Kurata would have reasonably arrived at the claimed polishing compositions encompassed by claim 1, including all of the limitations thereof as we interpreted this claim above, without recourse to Appellants' Specification. Indeed, in view of Kurata's disclosure that a combination of water-soluble polymers, which include polyvinyl alcohol and polyvinylpyrrolidone, can be

used in amounts that overlap the combined wt% range for polyvinyl alcohol and polyvinylpyrrolidone specified in claim 1, this reference alone would have suggested polishing compositions encompassed by claim 1 to one of ordinary skill in this art. *See, e.g.*, *KSR Int'l Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1739 (2007) ("The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results."); *In re Kahn*, 441 F.3d 977, 985-88 (Fed. Cir. 2006); *Merck & Co., Inc. v. Biocraft Labs., Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) ("That the '813 patent discloses a multitude of effective combinations does not render any particular formulation less obvious. This is especially true because the claimed composition is used for the identical purpose taught by the prior art."); *In re Corkill*, 771 F.2d 1496, 1497-1500 (Fed. Cir. 1985); *In re Kerkhoven*, 626 F.2d 846, 850 (CCPA 1980) ("It is *prima facie* obvious to combine two compositions each of which is taught by the prior art to be useful for the same purpose, in order to form a third composition which is to be used for the very same purpose. *In re Susi*, . . . 440 F.2d 442, 445 . . . ([CCPA] 1971); *In re Crockett*, . . . 279 F.2d 274, 276-77 . . . ([CCPA] 1960). As this court explained in *Crockett*, the idea of combining them flows logically from their having been individually taught in the prior art."); *In re Castner*, 518 F.2d 1234, 1238-239 (CCPA 1975) ("We agree with appellant that not every ingredient is shown in a single prior art reference. However, when the ingredients are associated in an obvious manner set forth in the claims, they do not co-act with each other in any new or unexpected way and define nothing patentable over the prior art." (citation omitted)); *see also In re O'Farrell*, 853 F.2d 894, 903-04 (Fed. Cir.

1988) ("For obviousness under § 103, all that is required is a reasonable expectation of success." (citations omitted)).

Appellants' contentions do not successfully rebut the prima facie case. We do not agree with Appellants' contentions that the one of ordinary skill in this art would not have arrived at the claimed combination of water-soluble polymers and other ingredients in view of the number of choices that each reference provides. App. Br. 3-5; Reply Br. 1. Indeed, the references consistently disclose the same or similar range of materials for each type of ingredient and one of ordinary skill in this art would have recognized that any combination of these ingredients will result in a suitable CMP composition having the properties taught by the references. In this respect, each of the references provide guidance to select non-ionic, vinyl-based polymers, of which polyvinyl alcohol and polyvinylpyrrolidone are two of five choices in Tsuchiya and two of three choices in Kurata. *See, e.g.*, *Merck v. Biocraft*, 874 F.2d at 807 (citing, among others, *Corkill*, 771 F.2d at 1500 ("obviousness rejection of claims affirmed in light of prior art teaching that 'hydrated zeolites will work' in detergent formulations, even though 'the inventors selected the zeolites of the claims from among 'thousands of compounds'")).

Appellants' contend that each of Tsuchiya and Kurata fail to disclose the claimed benefits of combining polyvinyl alcohol and polyvinylpyrrolidone. App. Br. 3-5. Appellants contend the comparison of Kurata's Example 4 composition with Comparative example 1 set forth in Kurata's Table 1 with respect to the CMP polishing rate of Cu, along with other disclosure in Kurata is evidence teaching away from combining the

two water-soluble polymers as claimed, and on this basis, submit that Appellants have proceeded contrary to such conventional wisdom which is evidence of non-obviousness. App. Br. 5. Appellants point out that in Table 1, the copper removal rate is 135 nm/min with Kurata's Example 4 composition, containing a polyvinyl alcohol, and 80 nm/min with the Comparative Example 1 composition, containing no water-soluble polymer. App. Br. 5. In this respect, Appellants urge us to "see earlier-submitted Declaration of Dr. Terrence Thomas,"[3] explaining only that in "item 7 . . . Dr. Thomas . . . notes that Kurata teaches that [polyvinyl alcohol] increases copper removal rate." App. Br. 5; Reply Br. 2. Appellants contend Kurata discloses that the protective film forming agent suppresses etching but does not function as a metal surface protective film when combined with a water-soluble polymer, thus "allowing a sufficiently high CMP rate." App. Br. 5, quoting Kurata ¶ 53, ll. 23-29. On this basis, Appellants contend Kurata discloses "the use of water-soluble polymer to maintain a high copper removal rate and . . . [Example 4] illustrates that [polyvinyl alcohol] increases copper removal rate," thus establishing "that the combined references teach away from the claimed invention." App. Br. 5; Reply Br. 2.

We cannot subscribe to Appellants' position. We determined that the claimed benefit of increasing the weight ratio of polyvinyl alcohol to polyvinylpyrrolidone with respect to decreasing the polishing removal rate

[3] The Declaration Under 37 C.F.R. § 1.132 (Thomas Declaration) was submitted with the Amendment filed April 25, 2006, and is attached to the Brief in the Evidence Appendix.

of non-ferrous interconnects was a relative property pertaining to the range of single compositions encompassed by claim 1 and not to a single composition to which the claim is directed. *See above* p. 4. Indeed, there is no base line for a water-soluble polymer weight ratio non-ferrous interconnect polishing removal rate set forth in claim 1 other than that obtained with any single composition encompassed therein, and Appellants have not argued a removal rate for a claimed composition or for the range of claimed compositions.

Furthermore, one of ordinary skill in this art would reasonably infer that two different water-soluble polymers can be used together from Kurata's teaching that "at least one" water-polymer can be used. This person would further find in Kurata's teaching at ¶ 53, lines 23-29, taken in light of the teachings of the reference as a whole, an explanation of the interaction between the water-soluble polymer and the film forming agent, and not a teaching or inference that the two kinds of ingredients should not be used together regardless of the specific compounds involved. *See also* Kurata, e.g., ¶¶ 0024 and 0035-0037. With respect to the evidence in Kurata's Table 1, the Example 4 composition exhibits a reduced copper CMP polishing rate than obtained with the compositions of Examples 1-3 that have different water-soluble polymers, while achieving a comparable Cu etching rate. Kurata teaches the benefits of such results. *See* Kurata, e.g., ¶¶0037 and 0103. Thus, contrary to Appellants' arguments and the testimony in the Thomas Declaration, the evidence in Kurata's Table 1 would have led one of ordinary skill in the art to select polyvinyl alcohol.

Accordingly, Appellants have failed to convince us that Kurata teaches away from the claimed CMP compositions. Indeed, as we determined above, Kurata alone would have suggested the claimed compositions encompassed by claim 1 to one of ordinary skill in this art, and there is no evidence of record that this person would have been led in a different direction by the teachings therein. *See, e.g.*, *Kahn*, 441 F.3d at 985-89 ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant." (quoting *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994))); *In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (prior art "disclosure does not criticize, discredit, or otherwise discourage the solution claimed").

Accordingly, based on our consideration of the totality of the record before us, we have weighed the evidence of obviousness found in the combined teachings of Tsuchiya and Kurata with Appellants' countervailing evidence of and argument for nonobviousness, including the evidence in the Thomas Declaration to the extent argued in the Brief and Reply Brief,[4] and conclude that the claimed invention encompassed by appealed claims 1 through 10 would have been obvious as a matter of law under 35 U.S.C. § 103(a).

The Primary Examiner's decision is affirmed.

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[4] *Cf. In re Baxter Travenol Labs.*, 952 F.2d 388, 391 (Fed. Cir. 1991) ("It is not the function of this court to examine the claims in greater detail than argued by appellant, looking for nonobvious distinctions over the prior art.").

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a)(1)(iv) (2007).

AFFIRMED

tf/ls

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